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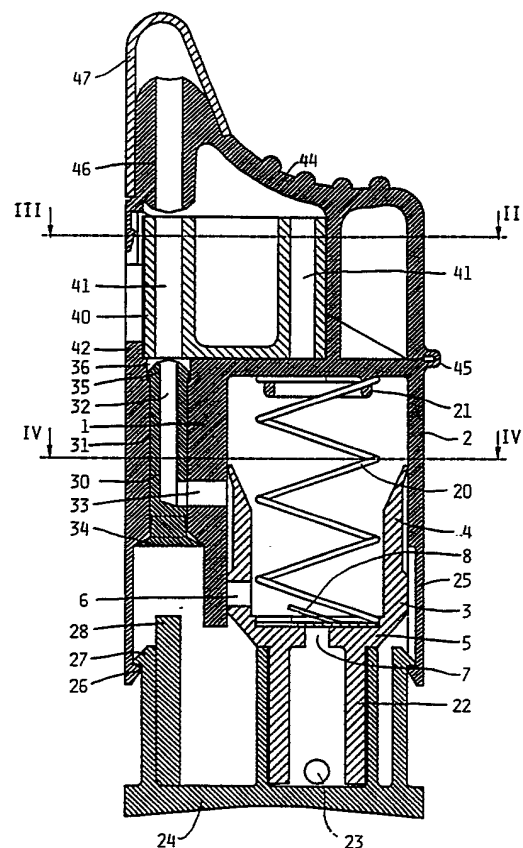
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Hyldetoften 6, Gundsoemagle, DK-4000 Roskilde (DK).(81) Designated States: AT (European patent), AU, BE (Euro-  
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DERED SUBSTANCE

## (57) Abstract

A manually operated dispenser for dispensing a predetermined amount of powdered substance comprises a pressure cylinder (2) with an axially displaceable piston (3). A superatmospheric pressure is generated by displacing the piston inwardly in the cylinder and is released through a chamber (41) in a magazine (40) comprising a number of chambers (41) containing powdered substance. The ends of the chambers (41) are covered by penetrable membranes, and the chambers (41) may be moved to successively being in alignment with a penetrator (30) and an outlet pipe (46). When the piston (3) is in its innermost position the penetrator (30) and the inlet end of the outlet pipe (46) are forced through the respective membranes at the ends of the chamber (41), and the subatmospheric pressure is released through the chamber (41) to dispense its content through the outlet pipe (46). The magazine (40) is annular and comprises a number of tubular chambers (41) placed equidistantly at some distance from and parallel with the axis of the magazine (40). At each full displacement of the piston (3) the magazine (40) is rotated to bring a new chamber (41) in alignment with the penetrator (30) and the outlet pipe (46).



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# MANUALLY OPERATED DISPENSER FOR DISPENSING A PREDETERMINED AMOUNT OF POWDERED SUBSTANCE

This invention relates to a manually operated device (in the following referred to as a dispenser) for dispensing a predetermined amount of a powdered substance, said dispenser comprising a pressure vessel having means for generating a superatmospheric pressure within said vessel, a chamber containing a predetermined amount of the powdered substance and a passage serving to connect the pressure vessel with the chamber following the generation of a sufficiently high pressure within the pressure vessel to expel the powdered material from the chamber.

Devices of the above mentioned type are used i.a. to dispense doses of powdered medicines and more particularly to introduce powdered medicines into the air passages and more particularly the nasal cavity of a patient.

US patent specification No. 2,151,418 discloses a device of the above-mentioned type. This known device comprises a compressible bulb which is connected with a compartment containing a capsule containing a dosage unit of a powdered medicine, the capsule being adapted to open when a superatmospheric pressure produced by the compression of the bulb exceeds a given value.

The known device suffers from the drawback that a new capsule has to be inserted into the compartment before each dosing and that it is difficult to prepare capsules which open at a given pressure and which are completely emptied after being opened.

Another known device of the type in question is disclosed in the specification of Danish patent application No. 3942/74. This known device comprises a compressible bellows and a capsule placed in a cavity having means for puncturing the capsule and a mouthpiece for insertion in the patient's mouth. The mouthpiece communicates through the cavity with a valve mounted in the passage between the bellows and the capsule, said valve being designed to open when the patient produces a subatmospheric pressure in the mouthpiece by suction.

The dispensing of the powdered material contained in the capsule is effected only if the patient produces the vacuum necessary to open the valve and, therefore, the known device is unsuitable in cases where the patient is unable to produce such a vacuum e.g. due to traumas in the air passages or the oral cavity or due to the general weakness of the patient. The known device also suffers from the drawback that a new capsule has to be inserted before each dispensing.

The object of the invention is to provide a simple device of the type defined in the preamble, which device can be used for dispensing a series of exact dosages of a powdered substance without being dismantled and which only requires that the user contributes in generating the necessary super-atmospheric pressure.

This object and other objects which will appear from the following description are achieved with the device of the invention, which device is characterized in that the pressure vessel comprises a pressure cylinder with an axially displaceable spring-loaded hollow piston and a one-way valve for the intake of air, valve means for connecting the interior of the cylinder to the inlet of said passage when the piston is displaced to its innermost position, the outlet end of said passage communicating with an inlet end of a chamber in a magazine comprising a number of chambers extending through said magazine and containing a powdered substance, the ends of said chambers being covered by penetratable membranes and said magazine being movable in such a manner that the inlet ends of the chambers therein can be moved successively into a position in which they are located in proximity of the outlet end of the passage.

According to the invention, the valve means may be provided by the portion of the hollow piston, which is in contact with the cylinder wall, comprising a hole which by axial displacement of the piston is brought into communication with a hole in the cylinder wall, which last hole is connected with the inlet end of the passage.

In the starting position the pressure within the pressure cylinder is atmospheric, but on axial displacement of the piston the pressure is gradually raised. The pressure rise

will continue until the hollow piston reaches a position in which the valve means are activated to connect the interior of the cylinder to the inlet of the passage.

At this stage a pressure wave of a predetermined magnitude will generate in the passage and said pressure wave will propagate towards the chamber which is located in proximity of the outlet end of the passage.

When the device, including the strength of the membranes covering the ends of the chambers, is suitably dimensioned the pressure wave will propagate into the chamber which has its inlet end located in proximity of the outlet end of the passage and the pressure wave will cause the powdered material to be completely expelled from said chamber.

The spring-load on the piston will cause the piston to retract towards its starting position and at the same time air will flow into the cylinder through the one-way valve.

When the piston has returned to its starting position and when another filled chamber has been introduced into a position in which the inlet end thereof is located in proximity of the outlet end of the passage, the device is ready for dispensing a further dosage.

The specifications of UK patent application No. 2102295, DE published patent application No. 2654019 and US patents Nos. 2,672,144 and 3,425,414 also disclose devices for dispensing powdered substances.

However, contrary to the device of the invention the known devices are based on the use of a propellant contained in a pressure vessel.

The one-way valve is preferably located in the end wall of the piston and it preferably comprises an elastic flap covering a hole in the end wall. The elastic flap may be part of a rubber disc covering a substantial portion of the end wall. The spring-load on the piston is preferably established by a helical spring provided in the interior of the cylinder and one of the ends of the helical spring is preferably resting on the above mentioned rubber disc so as to keep the disc in place.

The piston preferably comprises a piston rod which is connected with an activator having means for restricting the withdrawal of the piston thus preventing the piston from being forced out of the cylinder by the helical spring.

5           The device of the invention preferably comprises means for mechanically penetrating the membrane provided at the inlet end of each chamber in the magazine when the chamber is in a position where the inlet end thereof is located in proximity of the outlet end of the passage. These penetrating  
10 means preferably comprise a penetrator rod which is mounted so that it can be axially displaced in a passage provided in a housing surrounding the pressure cylinder.

In the embodiment wherein the valve means are provided by a hole in the piston wall being brought in align-  
15 ment with a hole in the cylinder wall the penetrator rod may be activated by a pressure rod. The pressure rod is preferably integral with said activator and its length is adapted so that shortly before the piston reaches the position in which the hole in the piston communicates with the hole in the cylinder  
20 wall the pressure rod exerts a pressure on the penetrator rod and causes said rod to be displaced towards the chamber containing the powdered substance over a distance sufficiently long to break the membrane covering the inlet end of the chamber.

25           In the embodiment wherein the valve means comprises a spring loaded valve the penetrator rod may be integral with the valve to be activated with this valve by the piston when this piston is axially displaced to its innermost position.

In a particularly preferred embodiment of the device  
30 of the invention a portion of the passage extends through the interior of the penetrator rod. The penetrator rod preferably comprises elastic means for retracting the rod towards its starting position when the pressure thereon is relieved and means for restricting the retraction.

35           The magazine is preferably located in a housing having a dispensing pipe having an inlet and an outlet end. The inlet end is preferably located in proximity of the downstream end of a chamber which is located in a position in which the

upstream end (inlet end) is located in proximity of the outlet end of the passage. The dispensing pipe is preferably pointed at its inlet end so that a displacement of the magazine by the penetrator rod causes the membrane covering the downstream end of the chamber to be broken.

When the device of the invention is to be used for nasal administration the downstream end of the dispensing pipe preferably has a shape so that it can be inserted into a nostril.

10           The magazine housing is preferably connected with the housing surrounding the pressure cylinder by means of a hinge.

          The magazine preferably has an annular shape and it comprises a plurality of, e.g. 12, tubular chambers spaced equidistantly and located at the same distance from the axis of  
15 the magazine and with the axes of the tubular chambers being parallel. Such a magazine permits the chambers to be moved successively into a position in which they are placed coaxially with the passage and between said passage and the dispensing pipe.

20           Another preferred embodiment of the device of the invention further comprises means for automatically rotating the annular magazine after each dosing in order to bring a new chamber in position between the passage and the dispensing tube.

25           These rotation means preferably comprise a guide rod extending axially from the activator and having a free end located in a groove on the exterior surface of the annular magazine, said groove being composed of sections extending parallelly with the axis of rotation of the magazine alternat-  
30 ing with sections forming an angle relative to said axis of rotation.

          When the activator is depressed the free end of the guide rod is advanced through one of the first mentioned groove sections, and when the activator has reached the position in  
35 which powdered material is expelled from the chamber which is in the dispensing position the free end of the guide rod will have reached the end of said first groove section at which the

groove section passes into a section forming an angle with the axis of rotation.

During the retraction of the activator to the starting position the free end of the guide rod will be withdrawn 5 through the inclined groove section thus causing the annular magazine to rotate over an angle which is related to the inclination of the inclined groove section. When such a rotation has been effected a new cycle can be started.

The invention will now be described in further detail 10 with reference to the drawings in which

- Fig. 1 shows a sectional side view of a preferred embodiment of the device according to the invention,
- 15 Fig. 2 shows a sectional side view corresponding to that of Fig. 1 but with the magazine housing opened and the protecting cap removed,
- Fig. 3 shows a cross sectional view along the line III-III of the device shown in Fig. 1,
- 20 Fig. 4 shows a cross sectional view along the line IV-IV of the device shown in Fig. 1,
- Fig. 5 is a schematic illustration of the mechanism for automatically rotating the magazine shown in Fig. 1-3,
- 25 Fig. 6 shows a sectional side view of another embodiment of the device according to the invention,
- Fig. 7 shows a cross sectional view along the line VII-VII of the device shown in Fig. 6,
- 30 Fig. 8 shows a cross sectional view along the line VIII-VIII of the device shown in Fig. 6.

The device shown in Fig. 1-4 comprises a cylinder housing 1 comprising a cylinder 2 surrounding a cup-shaped piston 3 which has a side wall 4 and an end wall 5. A hole 6 is 35 provided in the side wall 4, and another hole 7 is provided in the end wall 5. The hole 7 in the end wall 5 is covered on the interior side of the piston 3 by a rubber flap 8 which is part of a rubber disc 9 covering a substantial part of the end wall



5 and being maintained in position by a helical spring 20 which at the opposite end of the cylinder 2 is centered by an annular projection 21.

The piston 3 comprises a hollow piston rod 22 having an air inlet 23. An activator 24 is attached to the piston rod 22. The activator 24 is axially displaceable in a lower part 25 of the cylinder housing 1.

The lower part 25 of the cylinder housing 1 comprises at its free end an inwardly extending annular shoulder 26 which engages an outwardly extending annular flange 27 on the activator 24 when the latter is moved away from the cylinder 2. The activator 24 also comprises a pressure rod 28 which by activation of the activator 24 exerts a pressure on the end of a penetrator rod 30 which is axially displaceable in a passage 31 in the cylinder housing 1.

The penetrator rod 30 has an internal passage 32 which is connected with a hole 33 in the side wall of the cylinder 2. The end of the penetrator rod 30 which faces the push rod 28 is fitted with an elastic annular flange 34 and at its opposite end the penetrator rod 30 has an enlarged portion 35 which is mounted in a circular recess 36 in the cylinder housing 1. The elastic annular flange 34 and the thickened portion 35 of the penetrator rod 30 ensure that the penetrator rod 30 is axially movable over only a short distance and that it returns to its starting position when the pressure on the pressure rod 28 is relieved.

The thickened portion 35 of the penetrator rod 30 is pointed.

The device further comprises an annular , rotatable magazine 40 which has twelve identical chambers 41 each filled with a powdered substance (not shown). The chambers 41 are closed at both ends by a breakable membrane (not shown). The magazine 40 is surrounded by an annular flange 42 in which there is provided a window 43 and which constitutes a lower part of a magazine housing. The annular flange 42 has an inclined end surface corresponding to a similar inclined end surface on an upper part 44 of the magazine housing which is connected with the cylinder housing 1 by means of a hinge 45, cf.

Fig. 1 and 2. The upper part 44 of the magazine housing comprises a dispensing pipe 46 which is pointed at the end facing the magazine 40. The outlet end of the pipe 46 is covered by a removable protection cap 47.

5 As will appear from Fig. 3 and 5 the exterior surface of the magazine 40 has a groove 50 for guiding a pin 51 provided at the free end of a guide rod 52 (see Fig. 5) extending from the activator 24 and being mounted so that it can be axially displaced in a passage (cf. Fig. 3) in the cylinder  
10 housing 1. The groove 50 comprises twelve axially extending sections 53 alternating with twelve sections 54 extending at an angle relative to the sections 53 and connecting the ends thereof except that the last inclined section 54 passes into a thirteenth axially extending section of the groove which leads  
15 to the lower terminal surface of the magazine.

The depth of the groove sections 53 and 54 varies in the zones at which an axial section 53 passes into an inclined section 54 thus providing surfaces 55 which ensure that the magazine can rotate in one direction only relative to the pin  
20 51, cf. the arrow shown in Fig. 5.

The device illustrated operates as follows:

Before using the device the protective cap 47 is removed, and the outlet of the dispensing pipe 46 is placed in one of the nostrils of a patient. Subsequently, the activator  
25 24 is depressed.

Such depression causes the valve flap 8 to be pressed against the end wall 5 of the piston 3 so as to prevent air from escaping through the hole 7. By further depressing the activator 24 the pressure within the cylinder 2 is increased.  
30 The pressure increase continues until the holes 6 and 33 communicate. Shortly before this happens the pressure rod 28 will have pressed the penetrator rod 30 against the magazine 40 and have displaced said magazine 40 towards the pointed end of the dispensing pipe 46 so as to break the membranes covering the  
35 ends of the chamber 41 which is located in the dispensing position.

In this position there will be an open connection between the passage 32, the chamber 41, and the dispensing pipe

46 thus enabling the powdered substance to be expelled suddenly and completely from the chamber 41 when the holes 6 and 33 are brought into communication, and the pressure generated in the cylinder 2 is suddenly relieved.

5           The powdered substance expelled will pass from the chamber 41 to the dispensing pipe 46 and into the nasal cavity of the user.

          On depressing the activator 24 the pin 51 travels through an axially extending groove section 53 and passes into  
10 the transition zone between the axially extending groove section 53 and the inclined groove section 54.

          When the pressure on the activator is eased the helical spring 20 will return the piston and the activator to the starting position, and air will flow into the cylinder 2  
15 through the hole 7 in the end wall 5 of the piston.

          At the same time the pressure on the penetrator rod 30 is relieved thus enabling the elastic annular flange 34 to bring the penetrator rod 30 back to its starting position. During the retraction of the activator 24 the pin 51 will move  
20 through an inclined groove section 54 because the inclined surface 55 will prevent it from moving back into the axially extending groove section 53. Consequently, the magazine will be rotated over 30° so as to bring a new chamber 41 into dispensing position. The return of the activator 24 will stop when the  
25 annular flange 27 engages the shoulder 26.

          The device is then ready for dispensing a new dosage.

          When all chambers have been emptied the magazine housing is opened as shown in Fig. 2, and a new filled magazine  
40 is inserted.

30           When numbers readable through the windows 43 are provided on the external surface of the magazine 40 the user is able to determine the number of doses used or left without opening the magazine housing.

          The embodiment shown in Figs. 6-8 is much similar to  
35 the embodiment shown in Figs. 1-5, and corresponding details are specified by the same reference numbers.

          The main difference between the two embodiments lies in the construction of the valve means bringing the interior of

the cylinder in connection with the passage 32 through the penetrator rod 30. In the embodiment according to Fig. 6 this valve means has the shape of a spring loaded valve having a valve head 60 closing against a valve seating 61 in the upper wall of the pressure cylinder 2, and having its stem 62 protruding through said upper wall into the interior of the cylinder. When the piston 3 is displaced to its innermost position a block 63 provided on the inner side of the piston will abut the end of the valve stem 62 and lift the valve head 60 from its seat 61 against the force of a helical spring 64 surrounding the valve stem and abutting at its one end the inner side of the upper wall of the cylinder and at its other end a washer 65 press fitted on the valve stem 62. The penetrator rod 30 with its internal passage 32 has in this embodiment the shape of a short sleeve which is at one end connected to the valve head 60 by circumferentially spaced connections 66 so that the penetrator is activated by the valve being lifted.

The other end of the penetrator rod 30 is almost the whole way round along the edge of its internal passage 32 provided with a sharp brim 67 fitting into the opening of the chamber 41 which is in the dispensing position. Hereby the membrane of the chamber is cut free along the edge of the opening except for a thin rib which prevents the membrane piece cut free from being entrained by the air flow through the chamber.

After the membrane at one end of the magazine has been cut by the penetrator, this penetrator lifts the magazine pressing it against a corresponding sharp brim 68 provided at the inlet end of the dispensing pipe 46 to cut the membrane at the other end of the magazine.

PATENT CLAIMS

1. A manually operated dispenser for dispensing a predetermined amount of a powdered substance, said dispenser comprising a pressure vessel having means for generating a superatmospheric pressure within said vessel, a chamber containing a predetermined amount of the powdered substance and a passage serving to connect the pressure vessel with the chamber following the generation of a sufficiently high pressure within the pressure vessel to expel the powdered material from the chamber, characterized in that the pressure vessel comprises a pressure cylinder with an axially displaceable spring-loaded hollow piston and a one-way valve for the intake of air, valve means for connecting the interior of the cylinder to the inlet of said passage when the piston is displaced to its innermost position, the outlet end of said passage communicating with an inlet end of a chamber in a magazine comprising a number of chambers extending through said magazine and containing a powdered substance, the ends of said chambers being covered by penetratable membranes and said magazine being movable in such a manner that the inlet ends of the chambers therein can be moved successively into a position in which they are located in proximity of the outlet end of the passage.

2. Device according to claim 1, characterized in that the valve means are provided by the portion of the hollow piston, which is in contact with the cylinder wall, comprising a hole which by axial displacement of the piston is brought into communication with a hole in the cylinder wall, which last hole is connected with the inlet end of the passage.

3. Device according to claim 1, characterized in that the valve means comprises a spring loaded valve having a valve head closing against a valve seating in the upper wall of the pressure cylinder, the stem of this valve extending into the cylinder to be influenced by the piston to open the valve when the piston is axially displaced to its innermost position.

4. A device according to any of the preceding claims, **characterized** in that the one-way valve is provided at the end wall of the piston.

5. A device according to claim 4, **characterized** in that the one-way valve comprises an elastic flap covering a hole in the end wall of the piston.

6. A device according to any of the preceding claims, **characterized** in that the piston is spring loaded by a helical spring provided in the interior of the pressure cylinder.

10 7. A device according to any of the preceding claims, **characterized** in that the piston comprises a piston rod which is connected with an activator having means for restricting the retraction of the piston.

8. A device according to any of the preceding claims, **characterized** in that it further comprises means for mechanically puncturing the membranes at the ends of each chamber of the magazine when the chamber is located in proximity of the outlet end of the passage.

9. A device according to claim 8, **characterized** in that the mechanical puncturing means comprises a penetrator rod which is mounted so that it can be axially displaced in a housing surrounding the pressure cylinder.

10. A device according to claims 2 and 9, **characterized** in that the penetrator rod is activated by a pressure rod connected to the activator.

11. A device according to claims 3 and 9, **characterized** in that the penetrator rod is integral with the valve to be activated with this valve by the piston when this piston is axially displaced to its innermost position.

12. A device according to any of claims 9-11, **characterized** in that a portion of the passage extends through the interior of the penetrator rod.

13. A device according to any of the preceding  
5 claims, **characterized** in that the magazine is mounted in a housing which can be opened and which has a dispensing pipe, one end of which is located in proximity of the downstream end of a chamber, the upstream end of said chamber being located in proximity of the outlet end of the passage.

10 14. A device according to claim 13, **characterized** in that the inlet end of the dispensing pipe is pointed.

15 15. A device according to any of the preceding claims, **characterized** in that the housing comprises a lid which is connected with the housing surrounding the pressure cylinder  
15 by means of a hinge.

16. A device according to any of the preceding claims, **characterized** in that the magazine is annular and comprises a number of tubular chambers which are placed equidistantly and at the same distance from the axis, the chambers  
20 extending parallelly with said axis.

17. A device according to claim 16, **characterized** in that it further comprises means for automatically rotating the annular magazine when a chamber has been emptied.

18. A device according to claim 17, **characterized** in  
25 that the means for rotating the magazine comprises a guide rod connected with the activator, the free end of said guide rod being mounted in a groove on the exterior surface of the annular magazine, said groove being composed of groove sections extending parallelly with the axis of rotation of the magazine  
30 alternating with groove sections forming an angle with the axis of rotation.

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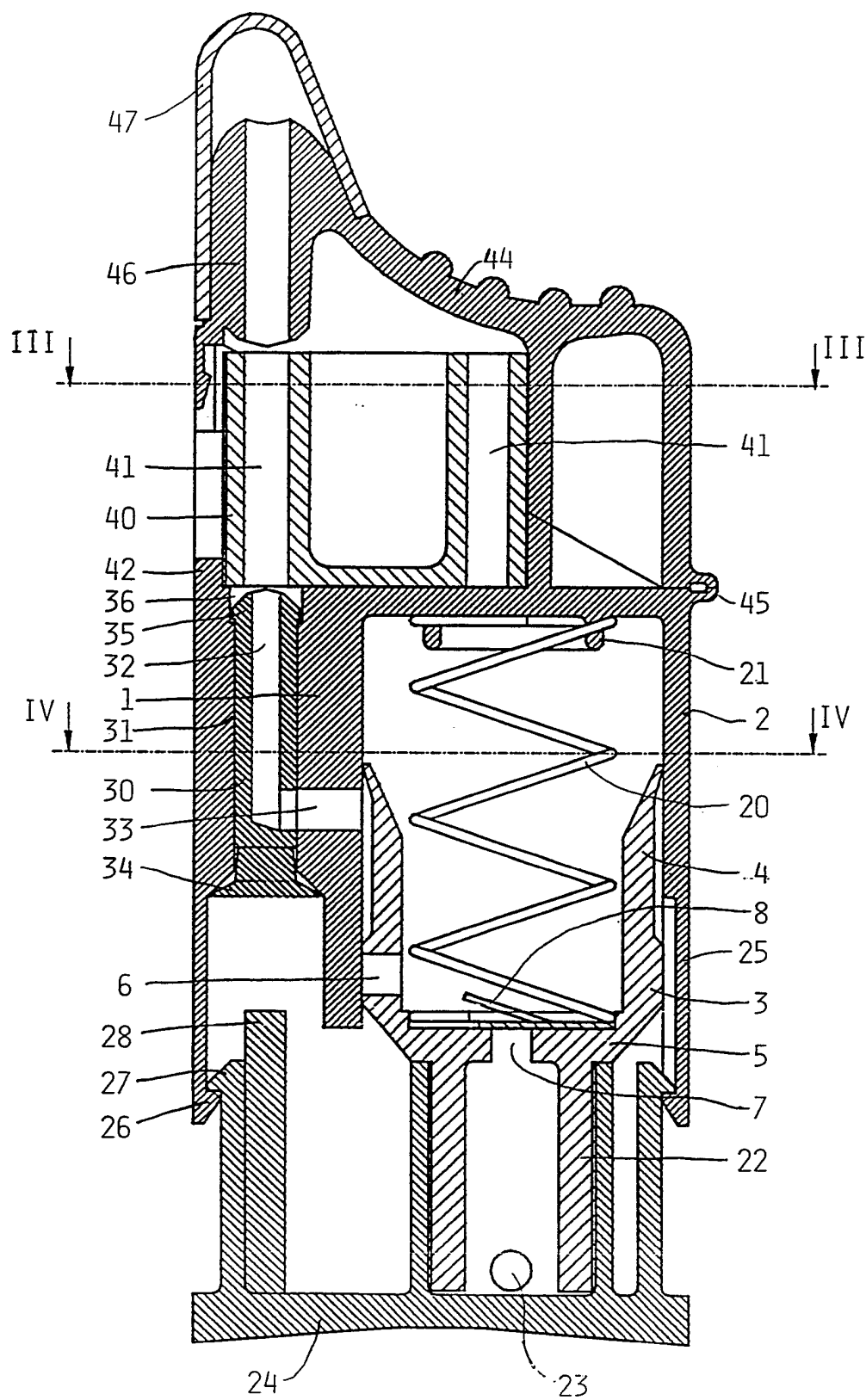


Fig. 1



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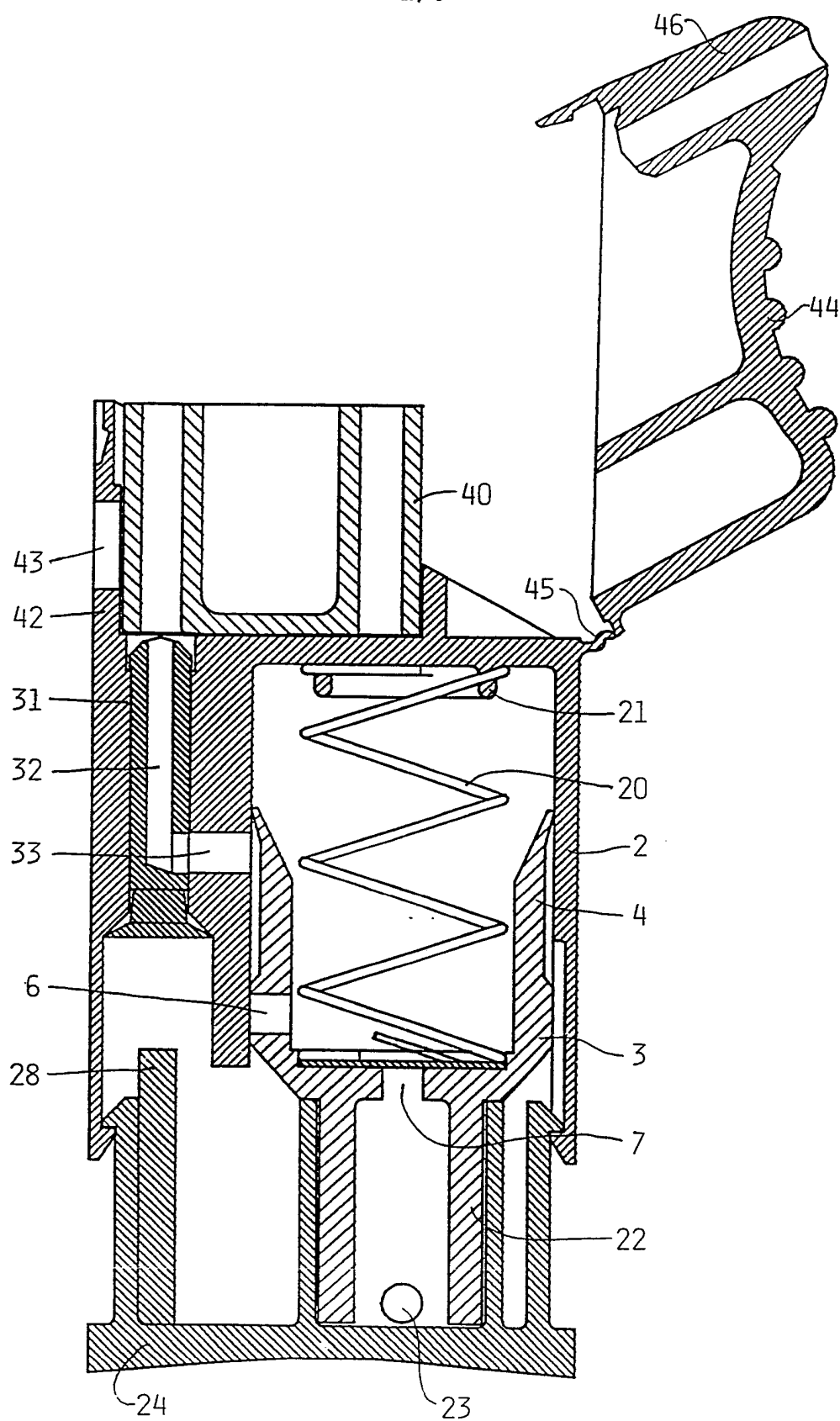


Fig. 2

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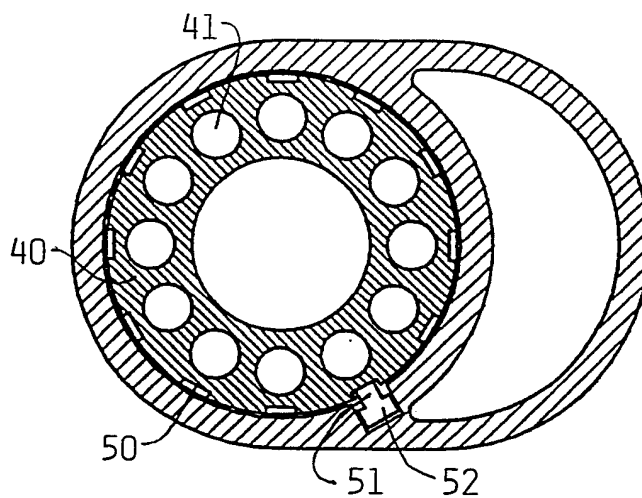


Fig. 3

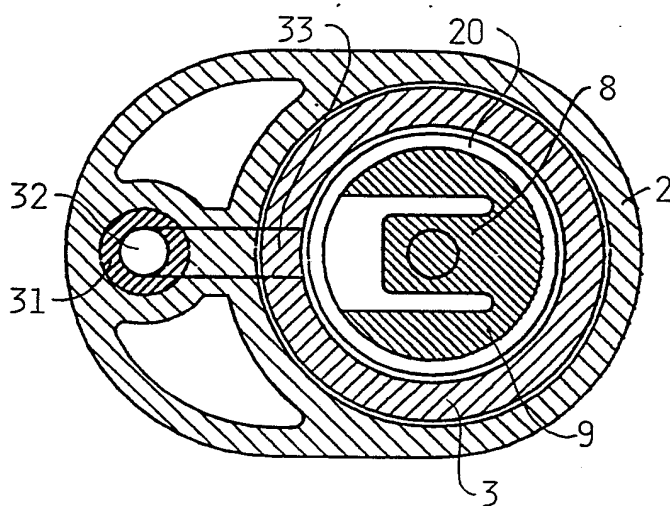


Fig. 4

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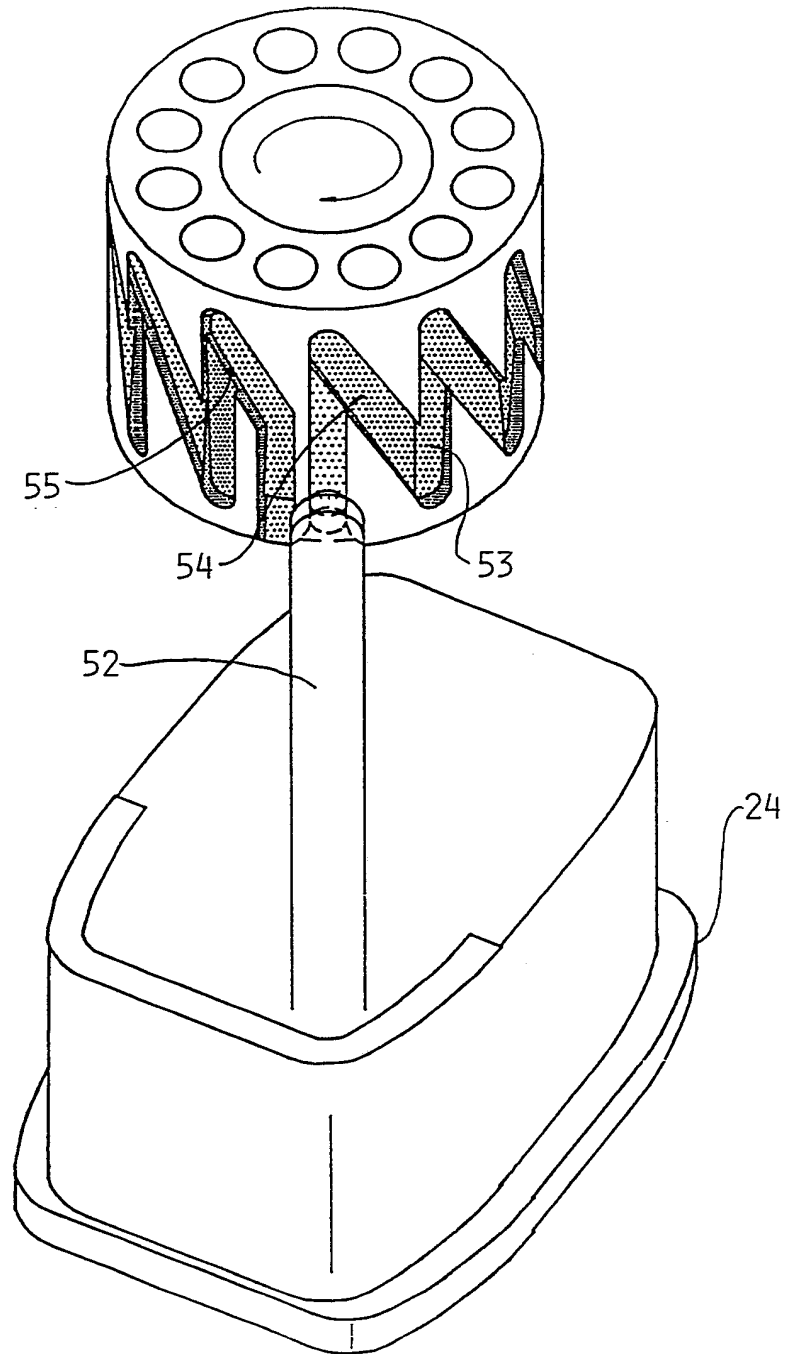


Fig. 5

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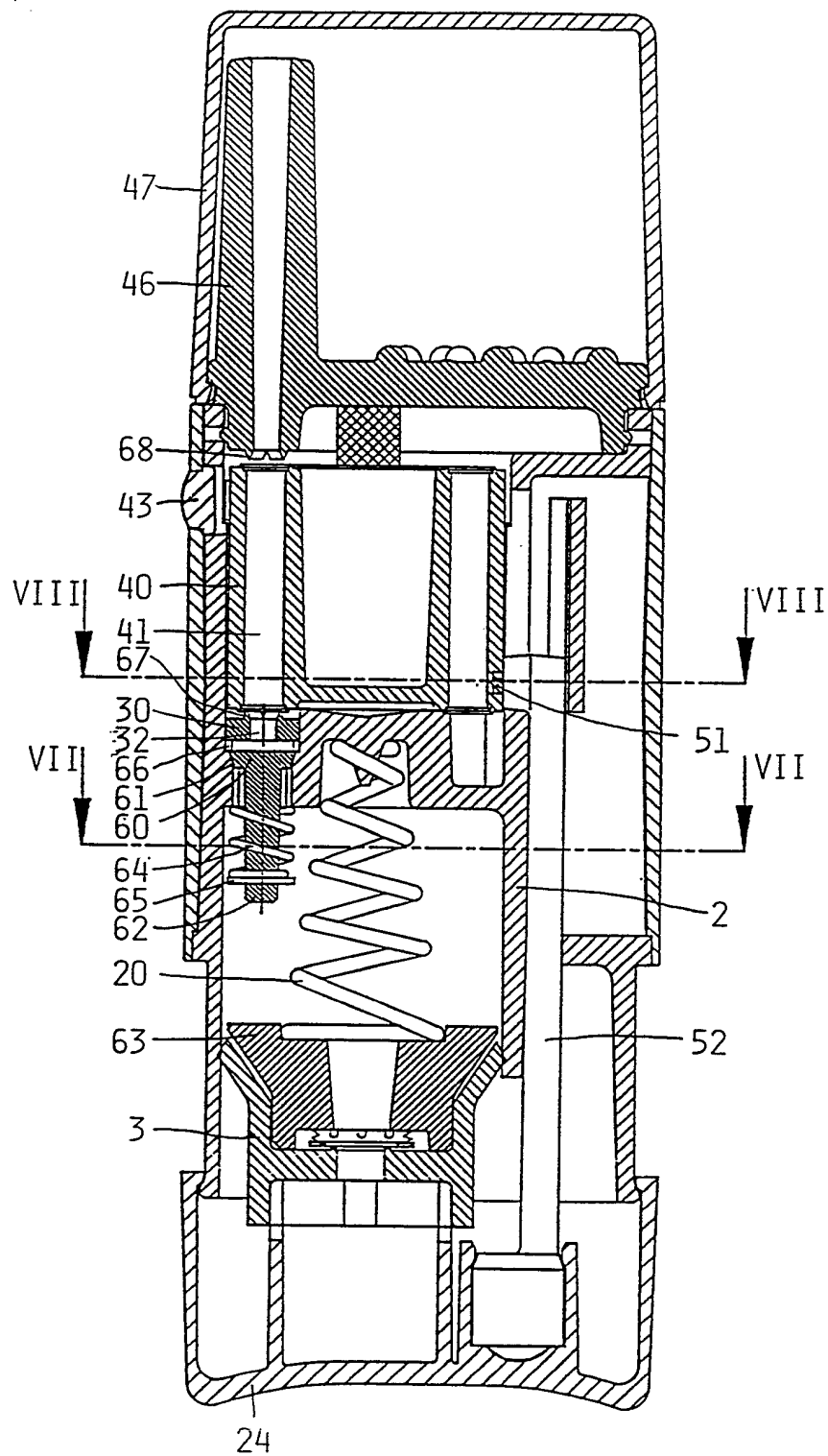


Fig. 6

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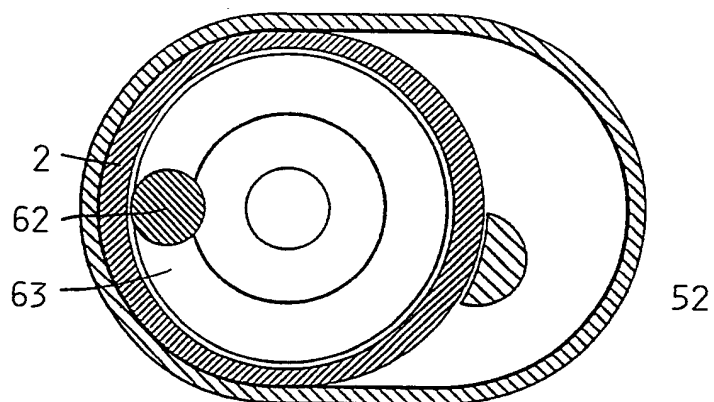


Fig. 7

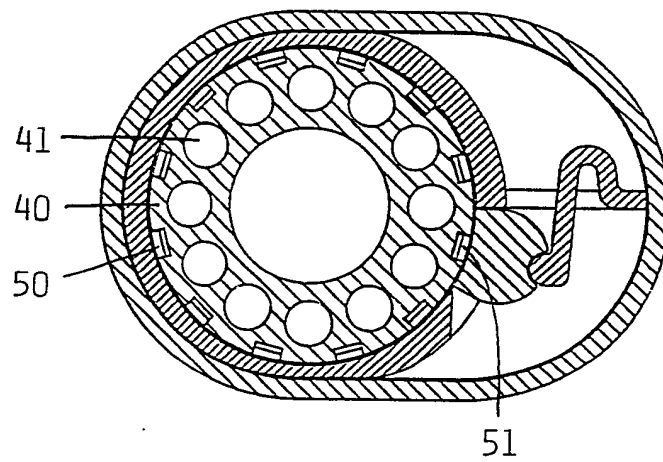


Fig. 8

# INTERNATIONAL SEARCH REPORT

International Application No PCT/DK 90/00273

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)<sup>6</sup>

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: A 61 M 15/00

## II. FIELDS SEARCHED

Minimum Documentation Searched<sup>7</sup>

Classification System

Classification Symbols

IPC5

A 61 M

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in Fields Searched<sup>8</sup>

SE,DK,FI,NO classes as above

## III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup>

Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
A	WO, A1, 8101243 (RIKER LABORATORIES, INC.) 14 May 1981, see the whole document --	1
A	US, A, 4116195 (JAMES) 26 September 1978, see the whole document -- -----	1

### \* Special categories of cited documents:<sup>10</sup>

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## IV. CERTIFICATION

Date of the Actual Completion of the International Search

Date of Mailing of this International Search Report

12th February 1991

1991 -02- 14

International Searching Authority

Signature of Authorized Officer

SWEDISH PATENT OFFICE

Lena Johansson

**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.PCT/DK 90/00273**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on **90-12-28**.  
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A1- 8101243	81-05-14	AU-B- 545574	85-07-18
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